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Tunneling Spectroscopy Study of Quasiparticle Spin-Injection Effects in Cuprate/Manganite Heterostructures*

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Quasiparticle tunneling spectroscopy was performed on epitaxial $YBa_2Cu_3O_{7-\delta}$ /$La_{0.7}A_{0.3}MnO_3$ (A=Ca,Sr) heterostructures, to study the microscopic effects of spin-polarized quasiparticle injection from the half-metallic ferromagnetic manganite on the high-T_C cuprate superconductor. Tunneling measurements of the cuprate overlayer (100nm thick) were made at 4.2K to minimize Joule heating in the manganite underlayer due to the injection current. The spectral characteristics observed were consistent with d-wave pairing symmetry, with a gap-maximum $\Delta_0 \approx 20$meV, and insensitive to the spin-injection up to 35mA. These low-temperature results suggest either: 1) the superconducting order parameter is invariant under a spin-polarized current density of up to 7×10^3 A/cm^2; or 2) the quasiparticle spin-depth [1] along the c-axis is much shorter than 100nm. Preliminary results taken at higher temperatures, and on samples with thinner cuprate layers and various cuprate/manganite interface conditions will be presented. General implications for the mechanism of magnetic pair-breaking, believed to cause critical-current suppression in the cuprate layer [2], will be discussed.

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